Variable Emissivity Electrochromics using Ionic Electrolytes and Low Solar Absorptance Coatings, Phase II

Completed Technology Project (2009 - 2012)

Project Introduction

This work further developed a highly promising variable emissivity technology for spacecraft thermal control, based on unique conducting polymer (CP) electrochromics combined with ionic electrolytes, developed earlier by this firm (Air Force, JPL) with: Extremely thin (< 0.2 mm), flexible (plastic), lightweight (0.192 kg/m^2), variable area, "skin-like" construction; Delta-Emittance > 0.4, emittance range 0.15 to 0.90; power 40 micro-W/cm^2; proven space durability (thermal vacuum, atomic-O, VUV, solar wind), operating temperature (-)70 to (+)105 C); use of ionic electrolytes with zero vapor pressure needing no seal; low cost (est. $5K/m^2). A technical hurdle in the earlier-generation technology, of high solar absorptance (values up to 0.8) in the dark, high-emissivity state, remained, the sole hurdle hindering implementation of the technology. The Phase 1 introduced the new innovation of unique, proprietary IR-transparent coatings lowering the solar absorptance (Alpha(s)) of the variable emittance devices ("skins") drastically. In Phase 1, the best coatings yielded Alpha(s) of 0.306, emittance of 0.383 for the light state, and Alpha(s) 0.454, emittance 0.841 for the dark state (Delta emittance 0.458), with a calculated temperature under direct sunlight in space of < 60 C. Devices endured thermal vacuum > 110 days, VUV, atomic-O exposure, abrasion tests. Calorimetric emittance measurements under space vacuum were identical to emissometer measurements in air. In Phase 2, the primary objective will be ground space qualification and a TRL of 7 or higher, with an extensive series of tests to include: thermal vacuum, thermal cycling, solar wind, atomic-O, micrometeoroid, vibration, ESD. These will be done in our labs as well as at several partner labs, including two large aerospace companies who are Phase 2 commercial partners, and several outsourcing vendors. At least one firm spaceflight opportunity has been identified. Expected TRL at end of Phase 2 is 7-8.

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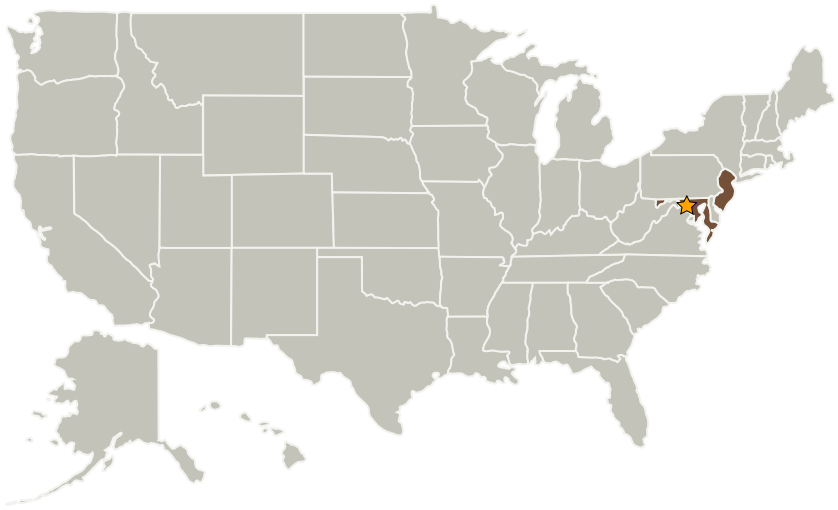
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Ashwin-Ushas Corp, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Holmdel, New Jersey

Primary U.S. Work Locations	
Maryland	New Jersey

Project Transitions

February 2009: Project Start

February 2012: Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.1 In-space Propellant Storage & Utilization